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Figs. 17, 18.—*Cnicus altissimus*, var. *discolor*, (Muhl.) Gray; 17, style $\times 30$; 18, brush hairs $\times 500$.

Figs. 19–21.—*Centaurea Americana*, Nutt. 19, 20, style $\times 30$; 21, brush hairs $\times 500$.

Figs. 22, 23.—*Taraxacum officinale*, Weber. 22, style $\times 30$; 23, brush hairs $\times 500$.

On the Evolution of Parasitic Plants.

When we observe the complete parasitism of *Phoradendron*, *Arceuthobium* and *Conopholis*, it is difficult to conceive that time was when they grew wholly in the ground. It is not necessary to use the expression, now common, that their ancestors were terrestrial. There seems no reason why these plants, as now existing, may not in the past have grown wholly in the ground.

When we consider the immense number of parasitic Loranths, and the close relation of that order to Santalaceous plants, we might assume some considerable evolution in order to bring the former to the parasitic condition, but for the fact that we find members of the latter family partially parasitic. In 1853 Mr. Jacob Stauffer of Lancaster, Pa., published a paper with drawings of a parasitic *Comandra umbellata*. Carefully washing out roots I could find no such attachment, but have since been rewarded by a beautiful case. The *Comandra* was obtaining most of its support from an attachment to a large root of *Vaccinium stamineum*. A case with an English ally of *Comandra*, *Thesium linifolium*, is noted in Bromfield's *Flora Vectensis*, and approvingly referred to in the third edition of Gray's Text Book. What is there to prevent that which is occasional from becoming habitual and permanent?

Partial parasitism is observed in many families. Mr. Stauffer, in the paper cited, illustrates *Gerardia quercifolia* and *Gerardia flava* in a similar condition, but I have never been able to find a case. This has also been reported of *Castilleja*. I exhibited at the Boston meeting of the American Association for the Advancement of Science carefully prepared colored drawings by Lunzer of *C. coccinea* showing its partial parasitism on the roots of grasses. So far as these instances are concerned it is clear that a plant may easily assume the habit of attachment without any serious modification of structure. We want only some illustrations of

seeds usually germinating in earth, sprouting and penetrating the bark from birth.

Passing from the chlorophyllous to the aphyllous parasites, I can vouch for the germination of seeds of *Aphyllon fasciculatum* directly on the stems of Geraniums when planted as cuttings beneath the soil; and carefully washing out the earth from *Aster corymbosus* in a locality where *A. uniflorum* is abundant, have seen the young plants starting from its fibres. *Epiphegus* I have also found in the earlier stages of growth attached to beech roots. On the other hand plants, which are scarcely parasites, have seed sprouting on bark to which the plant subsequently becomes attached. It is not always the decaying bark which receives the sprouting seed of the epiphyte. *Tillandsia usneoides* sprouts on the clear, glossy green bark of the orange tree. This may also be a partial parasite, though no direct penetration of the parts has been discovered. Dr. Chalkley Palmer analyzed the ashes, finding silica, iron, alumina, manganese, lime, magnesia, potash, soda, sulphur, chlorine, carbon and phosphorus. It is inconceivable that the Spanish moss should derive all these from the atmosphere.

I am convinced that a large number of root parasites require nothing but the ordinary earth to sprout their seeds in, and that many will live through their whole individual existence with nothing more in the soil than ordinary soil affords. My companion, in 1873, in Rocky Mountain exploration, Mr. Josiah Hoopes, found *Castilleja* seeds that grow as do any ordinary seed; and Mr. Isaac C. Martindale has recorded in the Botanical Gazette and Mr. Brown in the BULLETIN OF THE TORREY CLUB that *Orobanche* will germinate in ordinary garden earth, and go on with its development through all its stages as a well behaved member of the vegetable kingdom ought to do. I have shown in a recent issue of the Botanical Gazette that *Sarcodes sanguinea* has the same character. I have found *Monotropa* in soil with the slightest modicum of vegetable matter as often as actually among decaying leaves. Mrs. Harker, of Mount Holyoke Seminary in 1888, found *Cuscuta* germinating in the earth, which after finding something to fasten its fangs into, by the twisting of its stem, drew its roots out of the ground to die. It would be interesting to watch

and prevent parasitism, and then see how a *Cuscuta* would behave. *Corallorhiza* at the time of flowering has a large mass of coral-like tissue at the base. Transplanting these I find the plants live and flower several years. *Sarcodes sanguinea* with a similar and larger mass has not grown the second year for me.

It is clear that there is a varying power of adaptation in parasitic plants much greater than is generally supposed, affording a fine field for the student in evolution. I read a paper on this subject at the Boston meeting above cited; but, annoyed at the mysterious disappearance from the President's desk of my carefully prepared drawings, I did not publish it. But with some recent interest manifested the above facts may be worth recording.

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The Giant Sundew Heliotropic.

The *Drosera* of all American *Droseras* is the *D. filiformis*, and its abundance in the low ground at this time of the year is particularly striking. The round leaved species (*Drosera rotundifolia*) covers the otherwise bare white moist sand in many places and sends up its slender scapes bearing the small, erect, pale pink blossoms, while in the more grassy areas associated with the common pale yellow leaved pitcher plant (*Sarracenia flava*), the *Drosera filiformis*, thrives in all its attractiveness. At a distance of a few rods the blooms of this sundew might be mistaken for the rich orchid, *Calopogon tuberosus*, as the flower, fully an inch across, has the same beautiful bright purple color. The smooth erect scape is about a foot and a half high, therefore exceeding somewhat the extremely viscid filiform leaves which unroll from the top as they unfold. After a few days the old leaves have secured many small insects, and their neatness and peculiar beauty in the morning sun are somewhat impaired thereby.

But it is with the behavior of the blossoms that this note has particularly to do. Aside from the scape being many-flowered and the raceme hanging down like the bend of a shepherd's crook, it may be said that this curve straightens out fast enough, so that a new flower is brought out each day to the top of the bend, when it displays its rich colored corolla and showy yellow an-